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*ORIGINAL ARTICLE*

# Freshwater sponges and their associated invertebrates in the Great Lakes Basin (Mongolia)

**D.M. Palatov [1,2], A.M. Sokolova [3]**

*[1]Altai State University, Lenina 61, Barnaul, 656049, Russia*
*[2]Moscow State University, Biological Faculty, Leninskie Gory 1/12, Moscow, 119992, Russia*
*[3]N.K. Koltzov Institute of Developmental Biology, Vavilova 26, Moscow, 119334, Russia*
*E-mail: triops@ya.ru (Corresponding author)*
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The Great Lakes Depression is a large semi-arid region, whose freshwater invertebrate fauna is poorly known. Examining 37 waterbodies, we found freshwater sponges *Eunapius fragilis* and *Spongilla lacustris* (fragments) in the only one small river. Invertebrate species complex found on the sponges comprises nine species, their contribution to the assemblage was assessed by the metabolic intensity index.
**Key words:** freshwater sponges; Mongolia; Great Lakes Depression; symbiosis

## Introduction

Complex three-dimensional structure of sponges (Porifera) creates the conditions for living of many different organisms. They form a consortium, a community consisting of an edificator and a number of epibionts and endobionts (Beklemishev, 1951). Such communities are especially diverse in the seas, and many of them, in contrast to freshwater, have been studied in detail (Pansini 1970, Çinar et al., 2002 Palpandi et al., 2007; Padua et al., 2013, etc.). Spongillid sponges are common in rivers and lakes all over the world (Manconi, Pronzato, 2002), but their role as central members of consortia has been poorly studied to date. Knowledge on freshwater sponge-dwelling assemblages is presented by a few surveys, most of which are confined to the lists of species composition. Researches on this subject were conducted in Europe (Arndt, 1928; Konopacka, Sicinski, 1985; Trylis, 1997; Gaino et al., 2004), North and South America (Matteson, Jacobi, 1980; Resh, 1976; Melão, Rocha, 1996) and the Baikal region (Kamaltynov et al, 1993). However, freshwater sponges from vast territories of Central and Middle Asia (Rezvoj, 1926; Manconi, Pronzato, 2008) are poorly studied, and sponge-associated invertebrates in this region are almost unknown.
Recent sponges of Mongolia have not been studied at all earlier, except of the message about their absence in the Khuvsgul Lake (Müller et al., 2006). But the finding of imago of the caddisfly *Ceraclea fulva* (Rambur, 1842) (Mey, Dulmaa, 1985) having a larval stage obligatorily associated with spongillid sponges (Arndt, 1928) indirectly points sponge presence.
Sponge fauna of Mongolian drainless waterbodies (Great Lakes Depression and Gobi basins) is very perspective for research in the light of geological history of the region. In the end of the Mesozoic Era these waters and some basins of southern Tuva formed the system of large tanks joining the Pacific Ocean. Slow raise of the Altai and the Hangai caused their separation and aridization of its surrounding (Dulmaa, 1979). Nowadays the boundaries of this system can be traced by different ways. For instance, analyzing ranges of relict organisms, such as bivalvians *Tuvapisidium* spp. inhabiting waters of Tuva, Western Mongolia (Prozorova, Zasipkina, 2010) and the Gobi springs (unpubl. data), one can infer the kinship of presently separate waterbodies. Thus, there is a reason to expect some peculiarity of sponge fauna formed in this in this relict basin.

## Materials and methods

Total of 139 benthic samples were collected in the waters of the Hangai south slopes of the Great Lakes Depression from 06.06.2010 to 26.06.2010 (101 samples) and from 05.07. 2012 to 02.08.2012 (38 samples). All watercourses of these basins and most of lakes were inspected (total of 37 waterbodies).
Sponges were found only in the Teeliin-gol River (Great Lakes Depression, GPS coordinates 48°13'24.12"N, 93°25'41.68"E), which connects the Khar Lake and the Zavhan-gol River (fig. 1). Five sponges were detached from substratum by forceps or scalpel and fixed wholly together with associated animals in 4% formaldehyde. Another ten sponges were inspected visually

and invertebrates found on them were collected separately. The main index of assemblage characteristics was performed by the metabolic intensity (D), measured in ml $O_2/m^2h$ and described by the formula:

$D = k \times N^{0.25} \times B^{0.75,}$

where N is number of a specimens, B is biomass (g); *k* is a special for each group coefficient (Alimov, 1979). To clarify the role of organisms in the community, this indicator is more adequate than number and biomass, since it is directly related to energy needs (Vilenkina, Vilenkin, 1969, Kucheruk, Savilova, 1985).

Material was processed under stereoscopic trinocular microscope Carton TRIO0750, photos were made using the digital camera ToupCam 9.0 MP. Sponge spicules were purified according standard method (Manconi, Pronzato, 2000) and studied under Cam Scan S2 scanning microscope.

## Results

The Teeliin River extension totals just 12 km; it is an outflow of large and quite deep Lake Khar to the Zavhan River. Along the entire length it has width 4-5 m and current velocity about 0.3 m/s. The stream bed is wedged between frameworks of rocky bedrock exposure providing the stony substratum which is propitious for sponge developing.

Water temperature in the middle of June was 19°C. The watercourse does not undergo anthropogenic effect; surrounding landscape is a stony semidesert (fig. 2B).

Sponges, as well as other filter-feeders, abounded in the upper watercourse (not far than 2 km from the outlet); it is consistent with the concept of the lake effect (Richardson, 1984; Baryshev, Kuharev, 2011).

The most common sponge in the river was *Eunapius fragilis* (Leidy, 1851) which differs from known for Baikalia *E. fragilis* var. *rectituba* (Koshow, 1925) by quite long pore tube (fig. 2, C). Macroscleres are 120-240 μm length and 5-15 μm width, gemmuloscleres length is up to 90 μm and width about 4-10 μm (fig. 2, B).

Among animals found on the investigated *E. fragilis* caddisflies larvae dominated. The most essential was *Ceraclea fulva* (Rambur, 1842), which is well-known spongivorous insect using sponges fragments for case building. Their contribution to sum community metabolism is maximal (Table 1). Filter-feeder *Neureclipsis bimaculata* (Linnaeus, 1758) usually subdominated in assemblages.

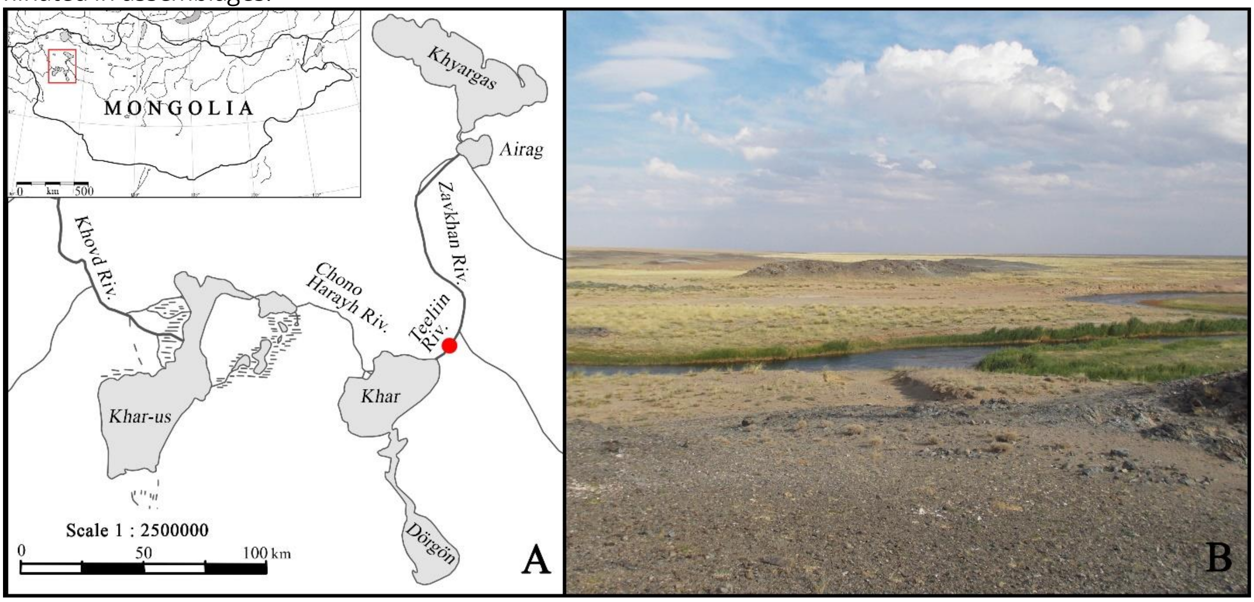


**Fig. 1.** A – Map of sample site and adjacent territories; B – Photo of the Teeliin River valley.

Large chironomid larvae mining sponges and gnawing out tunnels in their tissues play a significant role in sponge consortium. In fresh waterbodies of Palaearctic they are typically presented by *Demeijerea rufipes* (Linnaeus, 1761) and/or *Xenochironomus xenolabis* (Kieffer, 1916) (Schiffels, 2009). However, sponges of the Teeliin River were inhabited only by unspecific miners *Glyptotendipes paripes* (Edwards, 1929) also known as facultative sponge-feeder (Table 1).

A number of organisms was found on the sponges occasionally, and their role in the assemblage does not appear to be significant. They are nimphae of the spongivorous mites *Unionicola crassipes* (O.F. Müller, 1776), facultative sponge-feeder caddisfly *Hydroptila* sp., sponges' competitors bryozoans *Paludicella articulata* (Ehrenberg, 1831) and *Fredericella sultana* (Blumenbach, 1779), and mayflies *Baetis vernus* Curtis, 1834, *Caenis horaria* (Linnaeus, 1758), which are apparently not associated with sponges. Oligochaete worms *Chaetogaster diaphanus* (Gruithuisen, 1828) and *Nais barbata* Müller, 1774 were found on the sponge surface (on the dermal membrane). They did not comprise 5% of total metabolic intensity.

Except of *E. fragilis.* we found fragments of sponges with microscleres typical of the cosmopolitan species *Spongilla lacustris* (Linnaeus, 1758) (fig. 2, D) on stony bottom of the Teeliin River. We found no gemmules of *S. lacustris* (fig. 2, D), but wide fusiform microscleres allow us to assume the presence of this species. All found *S. lacustris* were very small and mixed with massive bodies of *E. fragilis*.

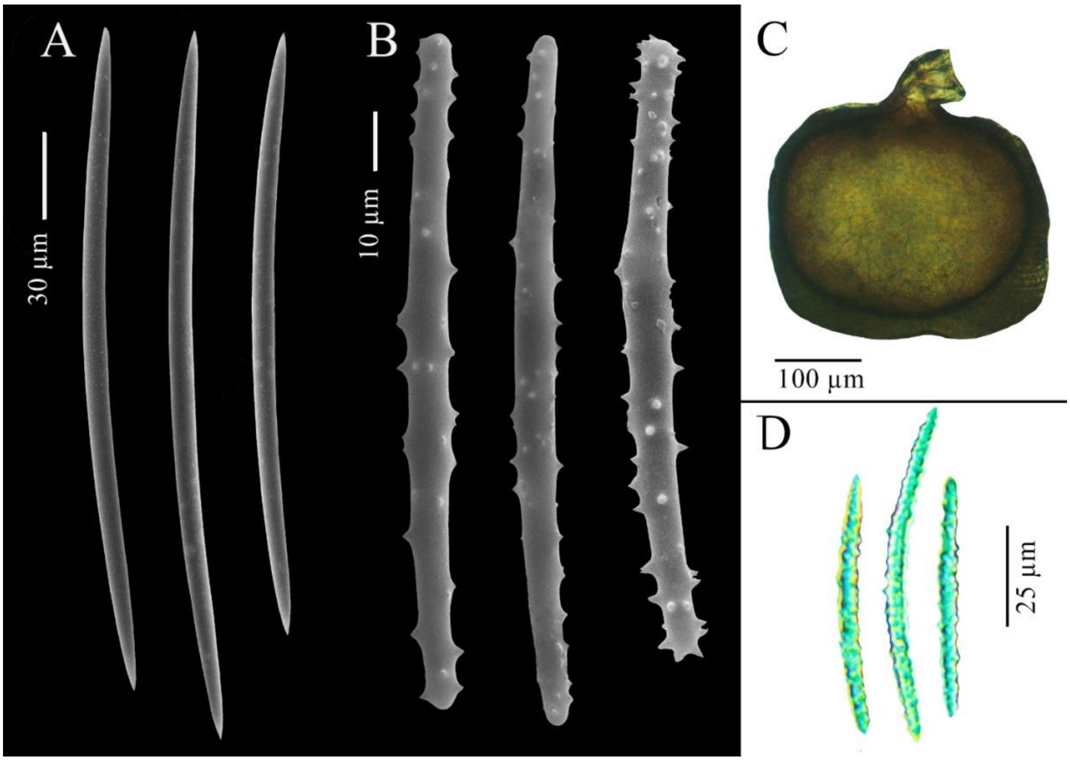


**Fig. 2.** *E. fragilis* (A-C) and *S. lacustris* (D) from the Teeliin River. A – Macroscleres; B – Gemmuloscleres; C – Gemmule in section; D – Miscroscleres of *S. lacustris*.

## Discussion

The species complex found on freshwater sponges of the Great Lakes Depression includes at least nine species. Only two of them, the caddisfly *C. fulva* and mite *U. crassipes*, are obligate sponge symbionts feeding on the host. The trichopterans, *N. bimaculata* and *Hydroptila* sp., as well as chironomid *G. diaphanus* are able to consume sponge tissues, but should be considered as facultative sponge-feeders, as they prefer other food sources. The assemblage is dominated by the species having direct trophic link with sponges, as in previously studied sponge-associated communities from European Russia and Far East (Sokolova, Palatov, 2014). However, oligochaetes, which are able to feed on sponges, are scarce on *E. fragilis* from the Teeliin River, while in previously examined waterbodies (Sokolova, Palatov, 2014) it comprised the essential part of the assemblage. The mite *U. crassipes*, though obligate sponge-dwelling, does not play significant role in the studied assemblage, as well as in the aforecited sponge-associated complex of invertebrates.

Apparently, the spreading abilities of some other sponge consorts, including the neuropteran *Sisyra* sp., are limited and do not allow them to inhabit such arid regions with a low density of water bodies suitable for the sponge existence.

The found sponges of the Great Lakes Depression are represented by the only two widely distributed species. Apparently, high mineralization and (in some cases) natural eutrophication of large lakes of the basin, which are caused by their shallowing and massive summer decay of aquatic vegetation, prevent successful development of sponges in these water bodies. No specific, relict species of sponges were found on the territory of the region.

**Table 1.** Species composition of animal complex found on the sponges

| Species | Contribution to assemblage, % $(D_i/\sum D)\times100\%$ | Ecological characters |
|---|---|---|
| Insecta: Trichoptera | | |
| *Ceraclea fulva* (Rambur, 1842) | 60 | Obligate sponge-feeder using sponge for case building (Arndt, 1928; Corallini, Gaino, 2003). |
| *Neureclipsis bimaculata* (Linnaeus, 1758) | 30 | Facultative sponge-feeder (Arndt, 1928) using sponge as a substratum and base for filter nets building |
| *Hydroptila* sp. | 4 | Facultative sponge-feeder, also using sponge for case building (Sokolova, Palatov, 2014) |
| Insecta: Diptera | | |
| *Glyptotendipes paripes* (Edwards, 1929) | 15 | Facultative sponge-feeder (Arndt, 1928; Schiffels, 2009). |
| Insecta: Ephemeroptera | | |
| *Baetis vernus* Curtis, 1834 | <1 | Algophagous, highly mobile |

| | | |
|---|---|---|
| *Caenis horaria* (Linnaeus, 1758) | <1 | Algophagous, highly mobile |
| Acari: Trombidiformes | | |
| *Unionicola crassipes* (O.F. Müller, 1776) | 4 | Obligate sponge-feeder (Arndt, 1938) |
| Annelida: Oligochaeta | | |
| *Chaetogaster diaphanus* (Gruithuisen, 1828) | 4 | Recorded as a sponge-feeder (Trylis, 1997), but generally considered to be a predator (Timm, 1987) |
| *Nais barbata* Müller, 1774 | 4 | Able to feed on sponges (Trylis, 1997); apparently combines filter-feeding and sponge-feeding (Timm, 1987) |
| Bryozoa: Ctenostomata | | |
| *Paludicella articulata* (Ehrenberg, 1831) | <1 | Sessile suspension feeder |
| Bryozoa: Plumatellida | | |
| *Fredericella sultana* (Blumenbach, 1779) | <1 | Sessile suspension feeder |

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